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# Breaking free: Gould's Bronze-Cuckoo nestlings can forge a second exit to fledge from domed host nests

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## Abstract

Gould's Bronze-Cuckoos *Chalcites minutillus russatus* frequently parasitize the domed nests of Large-billed Gerygones *Gerygone magnirostris*. Here we report three instances of cuckoo chicks creating a characteristic second exit in the narrow hooded entrance of the nest upon fledging. This behaviour may help cuckoo chicks to fledge securely from domed nests.

## Introduction

Dome nesting species are not common hosts for brood-parasitic cuckoos (Payne 2005) but are the primary hosts of Australian bronze-cuckoos *Chalcites* spp. (Higgins 1999). Both sub-species of Little Bronze-Cuckoo, *Chalcites m. minutillus* (Little Bronze-Cuckoo) and *C. m. russatus* (Gould's Bronze-Cuckoo) of northern Australia (Sorenson & Payne 2005; Joseph *et al.* in press), use Large-billed Gerygones *Gerygone magnirostiris*, as one of their main hosts (Higgins & Peter 2002). This host's suspended dome nest is well lined and has a hooded entrance, resulting in little sunlight reaching the nest cup. In an apparent adaptation to these unusual light conditions of gerygone nests, Little Bronze-Cuckoos have evolved cryptic eggs (Langmore *et al.* 2009). Unlike most other parasitic cuckoo species, the eggs of Little Bronze-Cuckoos do not mimic those of their host in appearance (Payne 2005). In contrast to the red-speckled, white shell typical of Large-billed Gerygones, Little Bronze-Cuckoo eggs are brown, olive or light green (Higgins 1999).

The specialization of Little Bronze-Cuckoos on dome-nesting host-species may not only affect the egg stage of parasitism but could also lead to adaptations in the cuckoo chicks. For instance, Little Bronze-Cuckoo nestlings have been found to suffer eviction from the nest by their foster parents (Sato *et al.* 2010). If the cuckoo chick evades eviction and manages to remove the host eggs and possibly nestlings through the small entrance hole of the nest, the cuckoo chick will grow up alone in an enclosed nest. This nest may not even fit the full grown cuckoo nestling (Seaton

1962), and the original hooded and usually tunnelled nest entrance could be too small to serve as an exit for a bird of that size.

We surveyed parasitized and un-parasitized nests of Large-billed Gerygones to determine how Little Bronze-Cuckoo chicks have adapted to fledging from a dome nest with a small entrance.

## Methods

The study was conducted in and around the city of Cairns (16°55'S, 145°45'W) and Mareeba on the Atherton Tablelands (16°59'S, 145°25'W), within the breeding range of both subspecies of Little Bronze-Cuckoos, from October to December 2007 before the breeding season was completed. We searched for Large-billed Gerygone nests along freshwater and saltwater creek lines and in mangroves, and followed active nests with and without cuckoo chicks until fledging or nest failure. Once nests were found they were visited every three to four days until chicks hatched and then every other day until fledging. In total, 24 nesting attempts were followed to completion. Predation was determined as the cause of nest failure where the nest was punctured, ripped apart or emptied prematurely. We considered a nesting attempt as successful if the nest was empty and a family group was seen or heard in the nest vicinity. After fledging we recorded and measured any additional exit holes from the nests, but we could not obtain reliable measurements of the original entrance because the nest entrance was widened when eggs and chicks were removed for measurements as part of another study (Langmore *et al.* 2009). For one nest we documented the fledging process of the cuckoo chick with a digital camera (SONY cyber-shot, DSC-W17, 14x digital zoom, 7.2 megapixel).

## Results

Our study followed 24 Large-billed Gerygone nesting attempts to completion; nine of which successfully fledged chicks, however, only two of the gerygone broods were successful as opposed to seven with cuckoo chicks (Table 1). Neither of the nests with only gerygone chicks showed a second exit, while three of seven cuckoos created a separate exit to leave the nest. Seven nests failed due to predation and three of those involved the puncture of the nest either at the side or the back of the nest (Table 1). All cuckoo chicks in our study were the sub-species Gould's Bronze-Cuckoo (*Chalcites minutillus russatus*) (unpublished mtDNA data, Langmore & Adcock).

Alternative exits created by the fledging cuckoos were invariably placed above the original nest entrance and measured (height by width in mm) 34.1 x 23.7, 28.0 x 27.6 and 29.0 x 33.0. By contrast, the alternative access to the nest during predation occurred once on the side and twice opposite the original nest entrance. A schematic drawing of one nest with cuckoo fledgling exit hole is shown in Figure 1.

**Table 1.** The fate of Large-billed Gerygone *Gerygone magnirostris* nests in a study population parasitised by Gould's Bronze-Cuckoo *Chalcites minutillus russatus* near Cairns, Qld.

| Nest fate | Number of nests |
|---|---|
| Cuckoo fledged through original entrance | 4 |
| Cuckoo fledged through alternative exit | 3 |
| Gerygones fledged through original entrance | 2 |
| Gerygones fledged through alternative exit | 0 |
| Predation through entrance or complete destruction | 4 |
| Predation through alternative opening | 3 |
| Parasitized nests lost to unknown causes | 5 |
| Unparasitized nest lost to unknown causes | 3 |
| **Total nests** | **24** |

We observed and photographed the fledging process of one cuckoo chick (Figure 2) that created an alternative exit in a nest suspended from a mangrove sapling at the shores of the salt water lake in the Cairns Botanic Gardens (16°54'09"S, 145°45'06"W). The process started at 0735 hours and lasted for approximately 15 minutes. During this time the host parents remained near the nest calling intermittently or visiting the nest entrance with food presumably to coax the nestling out of the nest. For the last five minutes the nestling created and repeatedly looked out of the alternative exit. After fledging, the cuckoo flew 2 m into the mangrove saplings behind the nest where it was attacked immediately by a pair of Brown-backed Honeyeaters *Ramsayornis modestus* whose nest with pin-feathered chicks was 5 m away from the gerygone nest. Both gerygone parents defended the cuckoo chick from the honeyeaters. After the honeyeaters stopped attacking the cuckoo chick, both gerygone parents repeatedly visited the nest to inspect its contents and then shepherded the chick away from the nest.

## Discussion

Our report of Gould's Bronze-Cuckoo nestlings creating a specific exit in the host nest for fledging is the first description, to our knowledge, of a behavioural adaptation specific to cuckoo chicks being raised in a domed nest. This observation illustrates that the relationship between the cuckoo and its host is not only shaped by the arms race between the two species (Davies 2000) but that brood parasitism also forces cuckoos to adapt their reproductive behaviour to each host's specific ecology.

We found that holes in the nest dome created by the cuckoo were distinctive in their position. Cuckoo exits differed from holes forged by predators, possibly Black Butcherbirds *Cracticus quoyi* which hunt for nestlings in mangroves (Higgins *et al.*

2006), in that they were invariably placed above the entrance and not at the back or to the side of the nest. Another distinctive feature of holes created by predators was their untidiness with nest-lining frequently protruding from the hole. Although it cannot be ruled out that a predator could have created a hole post-fledging it is unlikely as parent activity at the nest has been found to be a primary factor to attract predators (Martin *et al.* 2000).


**Figure 1.** Line drawing (A) and photograph (B) of a Large-billed Gerygone, *Gerygone magnirostris*, nest showing both the original entrance and the exit created by the cuckoo. The nest pictured is the same as shown in Figure 2 after removal from its original location to allow safe and clear photography.

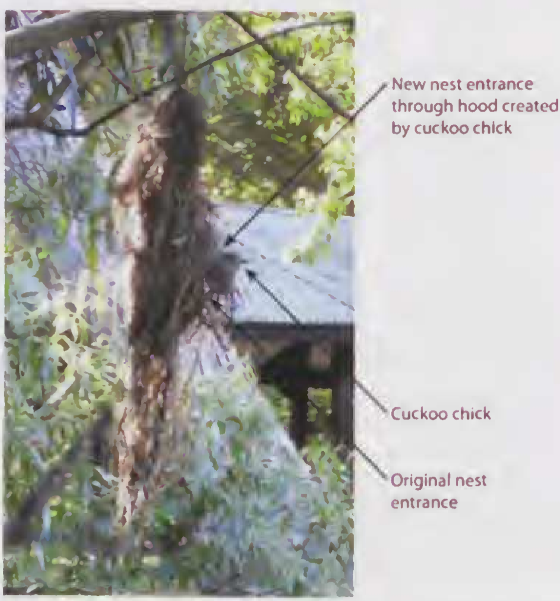


**Figure 2.** Chick of Gould's Bronze-Cuckoo, *Chalcites minutillus russatus*, shortly before fledging from nest of Large-billed Gerygone, *Gerygone magnirostris*, through an exit created by the cuckoo chick directly above the original nest entrance.

It is not clear why cuckoo chicks choose to create an additional exit for fledging when they are clearly aware of where the original nest entrance is, as they beg and are fed by their host parents through it. The size of the original entrance of Large-billed Gerygone nests is between 1.9-3.2 cm in diameter (Higgins & Peter 2002) and thus some entrances would be as big as those created by the cuckoo. Indeed, about half the cuckoos in our study did not create an alternative exit but used the original one. Cuckoo chicks should be able to widen original entrances that are too small as they can create wholly new additional exits, or even burst nests of dome nesting Olive-backed Sunbirds *Nectarinia jugularis* (Seaton 1962). The reason for this behaviour might therefore lie not in creating an appropriately sized exit, but in ensuring the cuckoo fledgling can leave the nest safely. The tunnelled entrances of gerygone nests could force the cuckoo to fledge downwards rather than upwards and also prevent it from surveying the area before leaving the nest. As Large-billed Gerygone nests are extremely variable in their location – in our study between 0.5 and 15 m high above water or dry land (ER, GM, unpublished data), cuckoo fledglings may drown if they left the nest downwards or were unaware of the next safe and dry place to perch. Gerygone fledglings may be less at risk of drowning, as they are further developed than cuckoos but smaller and hence possibly more agile (Andersson & Norberg 1981).

In addition, at the time of fledging cuckoo chicks are larger than adult gerygones and consequently are sitting very high in the nest dome. For such a big chick to leave a downward pointing entrance in such a low position is a biomechanical challenge. Creating a new entrance at a comfortable height and direction may thus not only be a safer but also a more 'convenient' option for the chick.

In order to conclude reasons for this behaviour further observational, and perhaps experimental, studies into Little Bronze-Cuckoo chick fledging behaviour is required. It would be worthwhile investigating any intra-seasonal or nest position and habitat variation of the occurrence of cuckoo fledging exits. Our sample in this study is too small to allow a conclusion on such variation.

The distinctive fledging exits of cuckoo nestlings could be used to indicate that a nest was parasitized. This is a particularly useful survey technique if the nests are too high to reach or can only surveyed after the breeding season. For instance, in a Northern Territory population of *C. m. minutus* along Ludmilla Creek and Leanyer Swamp near Darwin (130°51'E, 12°25'S), studied previously (Langmore *et al.* 2009), a similar opening was found in an unreachable nest after fledging and a cuckoo chick was being fed by Large-billed Gerygones nearby (GM pers. obs.). This observation is currently the only case of an additional exit in a Large-billed Gerygone nest recorded in the Darwin population. In addition five dome-shaped nests of Mangrove Gerygones *G. levigaster* were followed to fledging at this site, one of which contained a Little Bronze-Cuckoo chick. All fledged through the original nest entrance (Langmore, pers. obs).

The estimate of cuckoo parasitism achieved by this method can only be a minimum figure as not all cuckoo chicks will create an exit hole for fledging. Nonetheless, the method can help determine the incidence of cuckoo parasitism in a gerygone population outside the breeding season from their long lived nests (Higgins & Peter 2002). Furthermore, alternative exits could prove a useful indication of cuckoo parasitism in hitherto unknown cuckoo hosts of both sub-species of Little Bronze-Cuckoo, especially in its South-east Asian breeding range where very little information on the species' reproductive biology is available (Payne 2005).

In summary, alternative exits created by Gould's Bronze-Cuckoo fledglings appear to be an adaptation to safe and convenient fledging from dome-shaped Large-billed Gerygone nests and can serve as an indication of cuckoo parasitism.

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## References

Andersson M. and Norberg R.A. (1981) Evolution of reversed sexual size dimorphism and role partitioning among predatory birds, with a size scaling of flight performance. *Biological Journal of the Linnean Society* 15, 105-130.

Davies N.B. (2000) Cuckoos, Cowbirds and other Cheats. A. D. Poyser, London.

Higgins P.J. (1999) Handbook of Australian, New Zealand and Antarctic Birds. Volume 4: Parrots to Dollarbirds. Oxford University Press, Melbourne.

Higgins P.J. and Peter J.M. (2002) Handbook of Australian, New Zealand and Antarctic Birds. Volume 6: Pardalotes to Shrike thrushes. Oxford University Press, Melbourne.

Higgins P.J., Peter J.M. and Cowling S.J. (2006) Handbook of Australian, New Zealand and Antarctic Birds. Volume 7: Boatbill to Starling. Oxford University Press, Melbourne.

Joseph L., Zeriga T., Adcock G. and Langmore N. (in press). Phylogeography of the Little Bronze-Cuckoo (*Chalcites minutillus*) in Australia's monsoon tropics. *Emu*

Langmore N.E., Stevens M., Maurer G. and Kilner R.M. (2009) Are dark cuckoo eggs cryptic in host nests? *Animal Behaviour* 78, 461-468.

Martin T.E., Scott J. and Menge C. (2000) Nest predation increases with parental activity: separating nest site and parental activity effects. *Proceedings of the Royal Society B* 267, 2287-2293.

Payne R.B. (2005) Bird Families of the World: The Cuckoos. Oxford University Press, Oxford.

Sato N.J., Tokue K., Noske R.A., Mikami O.K. and Ueda K. (2010) Evicting cuckoo nestlings from the nest: a new anti-parasitism behaviour. *Biology Letters* 6, 67-69.

Seaton C. (1962) The Yellow-breasted Sunbird as a host to the Rufous-breasted Bronze-Cuckoo. *Emu* 62, 174-176.

Sorenson M.D. and Payne R.B. (2005) Molecular Systematics: Cuckoo Phylogeny inferred from Mitochondrial DNA Sequences. Bird Families of the World: The Cuckoos. Oxford University Press, Oxford.

Host and parasite:
Large-billed Gerygone (right), and Little Bronze-Cuckoo (below). (Trevor Collins)